Some Insights for UCSD Pascal Generation
offered by Ken Bowles, 22 October 2004

I was your current age when Mark Overgaard & I started what became UCSD Pascal
  • It was 30 years ago (give / take a few weeks)
  • I had just been forced to re-start in what amounted to 3rd of 5 careers.
  • Some of the reasons for those re-starts may now, or soon, be familiar to you too.

All but last (retirement) involved engineering at levels recognized as research in some major university engineering schools.

Rapid technology changes will (continue to) suggest you re-check reality occasionally.
Preview of this talk

Quick summaries of my 5 careers

• Activities, Objectives, Successes in each
• Reasons for moving on

Comments

• All transitions messy
• Work environment is dominant – many domains
• In modern engineering you’re almost always member of a team of people
• Team-based project-instruction works.
• Marketing success as important as technology
• Can’t win all battles
• What realistically might have been different

Engineering: “the discipline dealing with the art or science of applying scientific knowledge to practical problems”
(WordNet, Princeton University, 2003)
Career #1 - Radar Studies of Ionized Outer Atmosphere

We designed, built, and used this radar near Lima, Peru starting in 1960
• I worked for Central Radio Propagation Lab, Nat. Bur. Standards
Radar Studies -2-

Antenna Array Closeup

• We re-invented unpublished German antenna design from mid 1930's
Radar Studies -3-

Computers we used in 1963 period

Wilkes microprogram controller for transmitter pulses

Packard-Bell PB250 computer with mercury delay-line memory.
Radar Studies -4-

Success with the science . . . but it had to end . . . 1964
• Schools for our kids
• Budget competition amid changing national priorities

• Footnote: Jicamarca Radar Observatory now enjoying renewed US/worldwide support . . . re. satellite communications problems in equatorial ionosphere

Invited to help start Applied ElectroPhysics Dept at UCSD . . . 1965
• Gov't Lab to UC transition . . . culture shock
• Tangled with UC-wide restrictions re. lab computers
• Pushed into directing UCSD campus computer center
• Regrets at leaving Radar commitments and associations behind
1st Task . . . Replace aging CDC 3600 mainframe
   • Chose Burroughs 6500
   • Objectives . . . improved student & interactive services
   • Controversial . . . no longer best number-cruncher available

Instant Introduction to Software Engineering
   • Bx500 computers pioneered multi-program design, stack-machine
     . . . but needed fix to handle many small student jobs

   • Memory management and queue design were hot research topics
   • UCSD task-scheduler fixes were used on B6500's in univ's worldwide
Early participant in ARPAnet (now called Internet)
  • Reason: National & Statewide budget crunches for research
  • ARPA needed B6500 cycles for Illiac-IV development at U of Illinois
  • UCSD computer center usage had dropped
  • Collaboration with Burroughs & big users in tuning Op-System

Controversy grew . . . tried to serve many diverse user communities
  • County/UCSD hospital budget crisis - admin computing blamed
  • Big research number cruncher projects wanted supercomputer

But . . .
  • *Burroughs* told me B6500 lease had been cancelled by UCSD . . . while I was at Oxford Univ conference, summer 1974
  • I took instant sabbatical !!
Goal: Drastically increase student instructional computer use

Method: Take advantage of small computer price/benefit

Choice of Pascal

• Niklaus Wirth's P-H book quickly adopted at >300 C/S dept's
• Urs-Ammann's P-machine allowed (almost) instant Pascal on diverse machines
• Pascal a big influence on adding *Science* to Computer Science . . . P-H editor Karl Karlstrom helped to *market* Pascal

Computer Science only recently (in 1974) was getting accepted as university *discipline* independent of traditional disciplines

• Combined Electronics, Mathematics, Psychology
• Established departments competed for control of C/S
Engineering Approach

- P-machine similarity to B6500 stack machine hardware
- Used Assembly Language to implement P-machine on PDP-11
- Compiled Pascal on B6500 to write primitive UCSD Operating System, and to port Ammann’s compiler.
- Ammann’s Pascal Compiler re-compiled for UCSD P-machine
- Students developed Editor, Filer, . . . on PDP-11 using Pascal
UCSD Pascal -3-

Classroom Approach

• PDP-11 machines contributed by Digital Equipment Corp
• Used Keller's *self-paced* format for instruction
• Dared to teach intro-programming with Pascal for non C/S students . . . taught safer design habits
• Controversial among dept’s who preferred FORTRAN as default . . . though already known to be obsolete

Persuaded Terak to build cheaper LSI-11 small computer

• Terak/UCSD design widely adopted at other universities

Outgrew Terak lab, and moved to network of Apple II’s
Program Portability had grown to be a Major C/S Issue

- Proliferation of competing hardware/software prevented sharing of programs among collaborating groups in separate places
- Big NSF bucks were being spent on research looking for solution
- Intro of 8080 microcomputer end 1974 offered even lower costs for classroom
- Debut of competing LSI designs increased need for portable S/W

First Port to Z80 . . . a Revelation

- Lawrence & McCormack 1st trial demo in lab - early 1976
- First step . . . showed Sumner's Op System seemingly worked
- Plugged in floppy disk with Kaufmann's Editor
- All Pascal software worked on Z80 as on PDP-11 with no change!!
More CPU designs became popular . . .

More student implementation teams . . .

More $$$ needed to pay for teams to work . . .

I went on road show with Terak box to demonstrate
  • San Jose convention center . . . gasps of amazement !!
  • EDUCOM, ACM conferences
  • Cornell . . . to Tasmania C/S dept’s

More $15 licenses required serious Project *Infrastructure*
  • Documentation, Tech-Support, Accounting, . . .
We extended Wirth’s Pascal Language definition

- Needed to achieve efficient software on microcomputers
- Influenced by Smalltalk success at Xerox PARC
- Pascal needed *Objects* to cope with complexity of large software
- *String* processing capability for non-numerical work
- Programming Interface (*API*) support for various objectives

With fame came controversy over *Tinkering* with Wirth’s Pascal

- Purists regarded this as blasphemy
- We staged summer workshop seeking compromise toward international Pascal definition suitable for complex systems
- Proceedings distributed to participants . . . but never submitted for *publication* . . . we were overcome by events!!
The UCSD Pascal Micro-Engine

- Western Digital Corp built hardware for UCSD Pascal
- Team led by Mark Overgaard did the P-machine microcode
- Cited initially as proof of special CPU design advantages
- Barry Smith at Oregon Software soon proved that clever compiler design made Pascal code faster for the same chip with LSI-11 microcode

Licensing Controversy

- In late 70’s every vendor sought competitive advantage by altering, extending, . . . designs obtained from others.
- UCSD Pascal license written to prevent identifying altered software as “UCSD Pascal”
- Though paid for by those $15 fees, we were loudly accused of illegally preventing open use of code paid for by the public
UC Tax Status Sealed Our Fate in early 1979

• We were too successful !
• Though making no profit, income exceeded $10^6$ per year
• UC files no income tax return . . . but only if all income is from Teaching, Research, Public-Service
• UC-wide feared UCSD Pascal “unrelated-business” income would trigger IRS demand for tax return for all of UC

Three Options Offered

• Shut down “cold turkey”
• Ask Regents to request special IRS status for UCSD Pascal . . . might have established $$$ were for public service, but would have involved 2 year project suspension
• License an outside for-profit vendor, and stop licensing from UCSD itself . . . only choice fair to 1000’s of licensees already depending on us
UCSD Pascal -9-

I Spent 6 Months Shopping For Vendor . . . Negotiating, Marketing
- Talked a lot with people named Kildahl, Jobs, Gates and others who had small microcomputer software businesses
- Needed to select bidder with established business . . . led to SofTech, a software contractor to Fed Gov’t and Industry
- UC-wide Patents Administrator controlled the license
- SofTech MicroSystems was the licensee . . . initially staffed by graduates of UCSD Pascal project

Calif Fair Political Practices act . . . Proposition 9
- Prevented split appointment that would have permitted me to influence MicroSystems business decisions that were counter to UCSD interests
- I might have helped UCSD Pascal to compete more “fairly” against MS-DOS . . . especially re. royalties
Ada Language & TeleSoft -1-

Ada Language Design Sponsored by (D)ARPA starting late ’70s
  • Competition among several software contractors
  • Goal: basis for more reliable software in critical systems
  • Extensive consultation with C/S people from many univ’s
  • Winning design strongly influenced by Pascal
  • UCSD Pascal *Units* probably influenced Ada *Packages*

Western Digital CEO convinced me to start off-campus company
  • Goal: Build Ada-based software similar to UCSD Pascal
  • *Tele*… name: Plan to deliver our products via telephone
  • Initial Staff: Pascal project graduates & faculty colleagues

Financial realities soon led to merger with Renaissance Systems
  • UCSD spin-off founded by former Computer Center student employees . . . the team approach had worked there too!!
Market Realities Forced Us To:
  • Concentrate on compilers only . . . initially for VAX machine
  • Forget the Tele . . . another example when I was too early
  • Seek additional venture capital . . . and I lost control of T/S

Loss of Engineer Control of Company
  • Embarrassing promotion of flawed software
  • Abandoned efforts to educate potential users about benefits of using Ada . . . though marketing, not enough profit

Eventual Sale of Company to Swedish Telecom Admin (Telia)
  • Initial plan to employ TeleSoft Ada in new telephone switch
  • Abandoned when Ericsson programmers demanded C++
ISO and ANSI Ada Standards

- Early participation by UCSD Pascal “alumni” (both students and faculty) in DARPA’s Ada meetings led several of us to continue as members of ISO and ANSI Ada standards committees.
- Represented TeleSoft during 80’s & early 90’s
- I continued until Ada95 completed. Gary Dismukes is still involved (others too ??)
- Standards committees make decisions by consensus . . . they are important, but frustrating for participants.

By 1995, TeleSoft had been merged/re-sold several times

- I retired (from even part-time employment) then because we no longer had anything in common
- Most UCSD Pascal alumni had long since departed
Thoughts in Closing -1-

Migration from Engineering to Non-Technical Issues
  • Fact of life for most engineers
  • Tends to start age 35 . . . 50
  • Gets harder to compete with sharp people in their mid 20’s
  • Team development inevitably dulls all but the sharpest (those who are also most nimble coping with work environment)

Hard to avoid a career path explained partly by *Chaos Theory*

*Darwinian* evolution lamentably leads to less than optimum results.
  • IBM, though dominant in 60’s, has been passed by a small company started in an Albuquerque garage in 1975
  • Ada, Macintosh, Mosaic/Netscape, . . . still superior but now just niche products
  • Various outstanding products are now extinct . . . e.g. Burroughs stack machines, Xerox PARC’s ALTO machine, . . .
Thoughts in Closing -2-

Young Individuals (or Partners) Still Make Outsize Contributions

• Marc Andreesen & Eric Bina, while students at Univ Illinois’ NCSA, created Mosaic, 1st general Web browser, in 1992
• Larry Page and Sergey Brin launched Google while students working at Stanford’s digital library project in 1995

The Right Venture Investor Can Make a World of Difference

• Mike Markulla took the Steve’s (Jobs & Wozniak) under his wing to start and nurture Apple . . . one could feel the *symbiosis* when visiting their office

Software is fundamentally different from hardware

• Low manufacturing overhead, incentives to sell buggy S/W
• Too easy to tinker, low respect for standards
• Security concerns must/should not lead to rigid controls
Thoughts in Closing -3-

Serious Regrets

• My inability to arrange thesis committees for several outstanding students
• Getting forced to lay-off good employees during occasional budget crunch periods . . . which I was helpless to prevent

Serious Satisfaction

• Long list of accomplishments by UCSD Pascal alumni
• Recent renewed worldwide dependence on Jicamarca Radar, and on those Peruvian and American old-timers still contributing to the project
• Legacy influence of UCSD Pascal designs . . . though published only thru software distributions
Thoughts in Closing -4-

What Might Have Been . . .

• Richard Kaufmann has suggested that UCSD Pascal might have been allowed to continue at UCSD . . . had Open-Source licensing been accepted by UC at the time.

• Headline: “California Considers Open-Source Shift” . . . CNet, 27 Aug 2004

• Mozilla Foundation, Mosaic & FireFox licenses and support, widespread University participation . . . all provide an excellent updated model of what might have been

• ARPAnet provided the glue among many universities even in 1979 . . . and could have provided the “Tele”

• UCSD Pascal usage on IBM PC might have gone differently

Where would you be today had that happened? - Sigh . . . . . .
Thoughts in Closing -5-

Stay Active When You Retire

*Osmadenia tenella* (Three-Spot)  
see http://www.kenbowles.net